REMOVABLE MEDIA HOUSED IN A CREDIT CARD FORM FACTOR

CROSS REFERENCE TO RELATED APPLICATIONS

[1] This application claims priority from U.S. Provisional Application 60/456,633 titled, "REMOVABLE READ/WRITE MEDIA IN A CREDIT CARD FORM FACTOR," which was filed on March 24, 2003, and from U.S. Provisional Application 60/496,578 titled, "METHOD AND APPARATUS FOR ACCESSING REMOVABLE MEDIA IN A CREDIT CARD FORM FACTOR, "which was filed on August 8, 2003, both of which are incorporated by reference.

TECHNICAL FIELD OF THE INVENTION

[1] The present invention relates, generally, to the field of data storage and retrieval and more specifically, the present invention relates to a system and method directed to the storage and retrieval of data on a media housed by credit card form factor.

BACKGROUND OF THE INVENTION

[2] The capability of storing a large amount of data in smaller media has become prevalent in modern society. DVD-ROMs, CD-ROMs, cell phones, portable hard-drives, and the like provide an individual with the means to store,

transport, and retrieve large amounts of useful personal or other data simply by interfacing a system capable of reading from these forms of media. Such data that would be very useful to carry at all times include one's medical/dental history, next of kin contact data, personal banking data, and/or family history and information. Furthermore, because desires to carry this media readily at all times, it proves convenient to store this information in such a media that is durable, robust, low-cost, and small enough to fit into a pocket or one's wallet or purse.

[3] As such, a media in a credit card form factor (a standard for shape, thickness, and flexibility of the credit card) provides a convenient and popular way to store, transfer and transport data.

[4] In the past, one way in which data has been stored on a credit card form factor is by using a magnetic strip on the outside. In this well-known way, a magnetic strip is used to store a limited amount of data that typically included one's identification by name and an account number. When "swiped" in a credit card reader, the data may be retrieved. This system and method has proven useful for a limited amount of data, but is not practical for storing larger amounts of data. Further, there is no practical way to add or change the data once written to the magnetic strip. Additionally, the data is vulnerable to corruption in that the magnetic strip is exposed and often becomes compromised or damaged through physical use of the credit card or by stray magnetic fields near the credit card.

[5] Another solution of the past has been to use an integrated circuit(IC) chip embedded in the credit card form factor. Using this system and method, data

described above may be stored in a memory within the IC chip. Although, this solution provides a nominal amount of additional space for storage, it is still not enough memory space to store much more useful data, such as financial history, family and/or medical records and the like. Further, the IC chip is still exposed and may be data stored therein may still be compromised through typical use. Additionally, in order to read data from the IC chip, one needs an interface capable of interacting with the IC chip and retrieving the data in a known manner. Although, not difficult to implement, IC chip readers are not as prevalent as readers capable of retrieving data from a magnetized media, such as a magnetic strip or a hard disk.

[6] Thus, it would be quite advantageous to have the capability of storing a large amount of data (greater than 40 megabytes) in a media that is on or within a credit card form factor that proves to be physically robust and fault tolerant.

SUMMARY OF THE INVENTION

[7] In one embodiment, the present invention is directed to a credit card form factor having a removable media stored therein. The credit card form factor comprises a housing having an upper portion and a lower portion; the first and second portions attached to each other such that an enclosure is formed that may be accessed by manipulating at least one of the portions. The housing forms an enclosure for storing a removable media, such as a flexible magnetic media or optical disk. The media is operable to store data in a digital format

thereon. When used in a system, the removable media may be removed from the credit card form factor and data stored thereon may be manipulated. As such, a large amount of data can be stored on the removable media, yet still be protected inside the credit card form factor when being transported.

[8] In another embodiment, the present invention is directed to an apparatus for engaging a credit card form factor having a removable media. The apparatus comprises an interface operable to receive a credit card form factor having a removable media enclosed by a housing, a media-drive assembly operable to receive the credit card form factor and operable to remove the removable media from the housing, the media-drive assembly controlled by a controller, and a media drive operable to access data on the removable media. Thus, the removable media may be accessed, data read from it, and then replaced back in the credit card form factor for transport and later use.

BRIEF DESCRIPTION OF THE DRAWINGS

[9] The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

[10] **FIG. 1** shows an exploded view a credit card form factor having a removable media enclosed therein according to an embodiment of the invention;

[11] **FIG. 2** shows another exploded view of a credit card form factor having a removable media enclosed therein according to an embodiment of the invention;

[12] **FIG. 3** shows an isometric view of an assembled credit card form factor of **FIG. 1** according to an embodiment of the invention;

[13] **FIG. 4** shows a diagram of a system for using a removable media housed in a credit card form factor according to an embodiment of the invention;

[14] **FIG. 5** shows a block diagram of a controller within the terminal device of **FIG. 4** for controlling the media drive assembly according to an embodiment of the invention;

[15] **FIG. 6** shows an isometric view of various components of a media-drive assembly within the terminal device of **FIG. 4** according to an embodiment of the invention;

[16] **FIGs. 7A-7H** show a step-by-step representation of the overviewed process described with respect to **FIG. 6** according to an embodiment of the invention; and

[17] **FIG. 8** shows a flow chart of a method for manipulating a credit card form factor having a removable media and for storing data on and/or retrieving data from a removable media stored in a credit card form factor according to an embodiment of the invention.

DETAILED DESCRIPTION

[18] The present invention is directed to a system and method for using a removable media in a standard credit card form factor. A standard credit card form factor is a well-known term in the industry that refers to the typical parameters associated with common credit cards. For example, a typical credit card will have specific dimensions for width, length, and thickness. Further, the flexibility of the card itself is another parameter associated with a credit card form factor. These typical parameters have been standardized by the International Standards Organization in ISO/IEC 7810-7811. As such, the term credit card form factor, as used herein, embodies a card that strives to meet with the ISO standards. However, the underlying methods of the invention need not necessarily be practiced in the form of a credit card form factor as will become apparent throughout this disclosure. For example, the thickness of a credit card form factor according to some embodiments of the present invention may be greater (between 30 and 90 mils) than the ISO standard (which is 30 mils or less) in order to accommodate the removable media enclosed by the credit card form factor.

[19] **FIG. 1** shows an exploded view of a credit card form factor having a removable media enclosed therein by a housing according to an embodiment of the invention. In this embodiment, a credit card form factor, referred to as a media sleeve ***100*** throughout this disclosure, includes a removable media ***120*** enclosed by two portions, an upper portion ***110*** and a lower portion ***111*** of the media sleeve ***100***. Typically, the upper portion ***110*** and the lower portion ***111*** will

have the same topographical features in order to accommodate the other pieces (described below) within the media sleeve ***100***. However, the portions ***110*** and ***111*** may be of any size, shape and design, not necessarily similar to each other, such that the removable media ***120*** is still enclosed.

[20] Each portion, the upper portion ***110*** and the lower portion ***111***, of the media sleeve ***100*** includes depressions ***130a-d***. The depressions ***130a-d*** are located along one of the long sides ***161a/c*** of the media sleeve ***100*** and are disposed closer to the outer edges of the long sides ***161a/c*** of each portion ***110*** and ***111*** as shown in **FIG. 1**. The locations of the depressions ***130a-d*** are the same for both the upper portion ***110*** and the lower portion ***111*** such that when the media sleeve ***100*** is assembled, the depressions ***130a-d*** align with each other. That is, the first depression ***130a*** on the upper portion ***110*** aligns with the first depression ***130c*** on the lower portion ***111*** and the second depression ***130b*** on the upper portion ***110*** aligns with the second depression ***130d*** on the lower portion ***111***. When the media sleeve ***100*** is assembled (shown below in **FIG. 3**), the pairs of depressions ***130a/c*** and ***130b/d*** form holes (***301*** and ***302*** in **FIG. 3**) that are used during a media extraction process described below. In another embodiment, additional pairs of depressions (not shown) may be located on the other long side ***161b/d*** of the media sleeve ***100*** such that the extraction process (again, described below) may be accomplished from either long side ***161a/c*** or ***161 b/d*** of the media sleeve ***100***. Further, other pairs of depressions (not shown) may be on either short side ***160a/c*** and/or ***160 b/d*** of the media sleeve ***100*** such

that the extraction process may occur from the short sides as well. As described herein, only one side having depressions ***130a-d*** will be shown for example.

[21] The removable media ***120*** is typically a flexible magnetic media capable of storing at least 40 Megabytes of data. In other embodiments, the removable media ***120*** is another type of read/write storage such as a magnetic media sputtered on glass, ceramic, film, or metal or some form of optical media. The removable media ***120*** typically needs to be protected from being scratched or dented by small rocks and dust particles (or anything that may damage the removable media ***120***) that may come into contact with the removable media ***120***. As such two protective pads, an upper protective pad ***122*** and a lower protective pad ***121***, are disposed within the media sleeve ***100*** such that both faces of the removable media ***120*** only come into contact with the protective pads ***121*** and ***122*** when enclosed in the media sleeve ***100***. In one embodiment, the protective pads ***121*** and ***122*** are made of non-woven cloth.

[22] A magnetic ring ***115*** is attached to the lower portion ***111*** of the media sleeve ***100***. The function of the magnetic ring ***115*** is to center the removable media ***120*** and to hold it in place when enclosed by the media sleeve ***100***. A typical removable media ***120*** will have a center hub ***150*** that is made of a magnetic material and that has a chamfered edge. As such, when the removable media ***120*** is enclosed in the media sleeve ***100***, the magnetic ring ***115*** attracts and holds the hub ***150*** of the removable media ***120*** and keeps the removable media ***120*** securely in a centered position of the media sleeve ***100***.

[23] When the media sleeve ***100*** is assembled, the short sides ***160a-d*** of the media sleeve ***100*** come together such that side ***160a*** aligns with side ***160c*** and side ***160b*** aligns with side ***160d***. When assembled, the aligned short sides ***160a/c*** and ***160b/d*** are attached to each other such that they are prevented from separating. However, the aligned long sides ***161a/c*** and ***161b/d*** are not attached and may be separated (by bending open like a "media sleeve") by a force. Alternatively, one of the long side pairs ***161b/d*** may be attached to each other just like the short sides ***160a/c*** and ***160 b/d*** such that the long side pair ***161b/d*** is also prevented from separating. Further, the long sides ***161a/c*** and ***161b/d*** may be attached and the short sides ***160a/c*** and ***160b/d*** unattached for opening and retrieval.

[24] In order to maintain the media sleeve ***100*** in a "closed" position once assembled (*i.e.*, the long sides ***161a-d*** remain adjacent to each other, but not attached to each other such that the removable media ***120*** cannot be removed) the upper portion and lower portion are typically fabricated with a bias to a specific position. That is, the upper portion ***110*** and the lower portion ***111*** are each biased to a closed position but are flexible in accordance with typical standards for a credit card form factor. Thus, the media sleeve ***100*** when assembled may bend in any direction but will be biased to return to the original, biased, closed position. The long sides ***161a-d*** remain unattached to each other so that the removable media ***120*** may be removed when one of the long sides ***161a/c*** or ***161b/d*** are separated via bending to form an opening. That is, the upper portion ***110*** long side ***161a*** may be bent upward and the lower portion ***111***

long side ***161c*** may be bent downward creating an opening to extract the removable media ***120***.

[25] In yet another embodiment, the upper portion ***110*** and lower portion ***111*** may even be fabricated to have a slight bend in the opposite direction of bending direction when opening. Although not shown in the figures, the upper portion ***110*** may have a slight curve such that the short sides ***160a*** and ***160b*** are raised slightly with respect to the center. The lower portion may also have a slight curve in a similar fashion albeit in the opposite direction. As such, when assembled, the media sleeve ***100*** seals all the more tightly along its long sides ***161a-d*** because of the biasing imparted to the upper and lower portions ***110*** and ***111***. This will become more apparent when discussed below in conjunction with **FIGs. 3 and 7A-7H**.

[26] **FIG. 2** shows another exploded view of a credit card form factor having a removable media ***220*** enclosed therein according to an embodiment of the invention. In this embodiment, biased springs ***201*** and ***202***, typically comprised of stainless steel, are also enclosed within the media sleeve ***200***. Further, the removable media ***220***, the protective pads (not shown in **FIG. 2** for clarity) and the magnetic ring (also not shown in **FIG. 2**) may be housed within the media sleeve ***200***. The biased springs ***201a-b*** and ***202a-b*** engage each respective upper/lower portion ***210*** and ***211*** in such a way as to apply a force tending to maintain the closed position of each respective portion ***210*** and ***211*** of the media sleeve ***200***. That is, the two springs ***201a-b*** engaging the upper portion ***210*** are biased such that a force is applied outward to each short side ***260a*** and ***260b***.

When the upper portion ***210*** is bent upward (during the extraction process), the distance between the short sides ***260a*** and ***260b*** becomes less and the force exerted by the biased springs ***201a-b*** against the respective short sides ***260a*** and ***260b*** becomes greater. As such, in a closed position, the biased springs ***201a-b*** and ***202a-b*** help maintain the closed position of the upper portion ***210*** when not involved in an extraction process. The lower portion ***211*** and associated engaged springs ***202a-b*** are configured in a similar manner and behave accordingly similar albeit in an opposite configuration so as to complement the upper portion ***110***.

[27] Further, the combination of forces exerted by the biased springs ***201a-b*** and ***202a-b*** on the short sides ***260a-d*** of the media sleeve ***200*** tend to force the long sides ***261a-d*** to seal tightly closed. As a result, the tight seal prevents moisture and particulates from getting inside the media sleeve ***200*** that may damage the removable media ***220***. Further, an additional sealing mechanism (not shown) may provide additional protection from moisture and particulates getting inside the media sleeve ***200***. For example, the sealing mechanism may include formed grooves that interface to form a more protective seal. Alternatively, the sealing mechanism may be magnetic.

[28] The interior topography of the upper portion ***210*** and the lower portion ***211*** may also be such that recesses, such as media recess ***250***, help align the various pieces within the media sleeve ***200***. The biased springs ***201a-b*** and ***202a-b*** may also have recesses (not shown for clarity) that help align the biased springs ***201a-b*** and ***202a-b*** within the media sleeve ***200***.

[29] **FIG. 3** is an isometric view of an assembled media sleeve ***100*** of **FIG. 1** according to an embodiment of the invention. As can be seen, the depressions ***130a-d*** described above with respect to **FIG. 1**, have come together to form holes ***301*** and ***302***. Again, in some embodiments, an additional set of depressions (not shown) may also be located on the other long side of the media sleeve ***100*** or on one of the short sides. The holes ***301*** and ***302*** allow pins (not shown in **FIG. 3**) to open the media sleeve ***100*** during an extraction process. The removable media ***120*** is shown by hidden lines in **FIG. 3** as it is located inside the media sleeve ***100***. An extraction process is described below with respect to **FIGs. 7A-7H**.

[30] The media sleeve ***100*** may also have many conventional features of a typical credit card. Although not shown in the figures, one may appreciate that a photo ID may appear on the outside of the media sleeve ***100***. Further, an IC chip (contact and/or contactless) may be embedded in the media sleeve ***100*** along with related circuitry and contacts. Still further, a magnetic strip having data stored thereon may also be disposed on the outside of the media sleeve ***100***. Still further yet, additional information in the form of a bar code stamped onto the media sleeve or the owner's name and standard credit card number may be stamped onto the media sleeve ***100***. In essence, any conventional feature of a typical credit card may be incorporated into the media sleeve ***100*** of **FIG. 3**.

[31] **FIG. 4** shows a diagram of a system for using the credit card form factor of **FIG. 1** according to an embodiment of the invention. The system ***405*** includes a terminal device ***400*** that is configured to interface with a removable media ***120***

enclosed in a credit card form factor. The media sleeve ***100*** described above with respect to **FIGs. 1-3** may be used in conjunction with the terminal device ***400*** such that the removable media ***120*** may be accessed to retrieve data from or store data to the removable media ***120***. The terminal device ***400*** shown in **FIG. 4** includes a media drive assembly ***420*** that is configured to control the manipulation of both the media sleeve ***100*** and the data stored on the removable media ***120*** once the removable media ***120*** has been extracted from the media sleeve ***100***. Specific aspects of the media drive assembly ***420*** are described in greater detail below in **FIGs. 5** and **6**, respectively.

[32] In this embodiment, the terminal device ***400*** is connected to a network ***430*** such that a conventional communication component (not shown) having a transmitter and receiver may transmit and receive data from the network ***430***. The network ***430*** may be any type capable of passing data between the terminal device ***400*** and other devices connected to the network ***430***. For example, the network ***430*** may comprise a typical Local Area Network (LAN) or a Wide Are Network (WAN). Other devices connected to the network ***430*** (also having conventional communication components for transmitting and receiving data over a network) may include another terminal device ***470***, a server computer ***480***, or a host computer ***450*** having a user application ***455*** running thereon. Typically, the user application ***455*** is configured to use data that may be stored on or retrieved from the removable media ***120*** at the terminal device ***400***. Examples of user applications ***455*** include point-of-sale applications, medical applications, and the like.

[33] Note that while the example shown in **FIG. 4** shows a terminal device ***400*** that is remote from a host computer ***450*** (and the respective user application ***455***), it is possible that the user application ***455***, the host computer ***450***, and the terminal device ***400*** may be contained within the same unit. Thus, in some embodiments, the need for the network ***430*** is eliminated. For example, a ticketing kiosk (not shown) may contain a dedicated host computer ***450*** running a user application ***455*** that is connected directly to the terminal device ***400*** via a universal serial bus (USB) connection.

[34] **FIG. 5** shows a block diagram of a controller ***410*** within a terminal device ***400*** for controlling the media drive assembly ***420*** according to an embodiment of the invention. A microprocessor ***510*** is connected to a data bus ***513*** and an address bus ***517*** in a conventional manner. The microprocessor ***510*** is a conventional microprocessor as is well known in the art, thus, the procedures and operations regarding the microprocessor ***510*** are not discussed further herein.

[35] A host input/output port ***540*** is also connected to the data bus ***513*** and the address bus ***517*** and provides a means for communication between the microprocessor ***510*** and a host (such as the host computer ***450*** of **FIG. 4**) via a USB connection ***545***. Using this host I/O port ***540***, the host computer ***450*** may pass status and command data back and forth with the microprocessor ***510***.

[36] The microprocessor ***510*** is also connected to a drive input/output port ***530*** via the data bus ***513*** and the address bus ***517***. The drive I/O port ***530*** passes commands and data from the media-drive assembly ***420*** to the

microprocessor ***510*** and/or the host computer ***450*** depending on the specific task. For example, when a removable media ***120*** is loaded into a terminal device ***400***, the media-drive assembly ***420*** relinquishes control of the removable media ***120*** until the microprocessor ***510*** indicates that the controller ***410*** is finished reading/writing data on the removable media ***120***. Thus, control of the removable media ***120*** is given (via a command through the drive I/O port ***530***) back to the media-drive assembly ***420*** so that the removable media ***120*** may be returned to the media sleeve ***100***.

[37] Several modules ***520-527*** contain software and firmware instructions for controlling the various devices and apparatus associated with a typical terminal device ***400***. Each of these modules ***520-527*** is connected to the data bus ***513*** and the address bus ***517.***

[38] A memory module ***520*** contains the necessary instructions, in the form of software code, to execute various methods of the present invention (described further below with respect to **FIGs. 7A-7H**).

[39] A sensor-state-table (SST) module ***527*** contains the logical code for interpreting the status of sensors (described below with respect to **FIG. 6**) associated with the media-drive assembly ***420***.

[40] A motor-control module ***526*** and arm-control module ***525*** use the data from the SST module ***527*** to activate appropriate actions (described below with respect to **FIGs. 7A-7H**) to manipulate the media sleeve ***100*** and the removable media ***120***.

[41] An error-handling module ***524*** contains instructions that enable the terminal device ***400*** to initialize upon startup and/or react to abnormal situations (such as no removable media ***120*** found in a media sleeve ***100***). Should an error occur during the process, the error-handling module ***524*** recognizes a deviation from the normal processes and, in response to a particular deviation, causes a corrective action to be taken.

[42] A drive I/O port module ***523*** contains instructions for interfacing with the media-drive assembly ***420*** via the previously described drive I/O port ***530***. Similarly, a host I/O port module ***522*** contains instructions for interfacing with the host computer ***450*** via the previously described host I/O port ***540***.

[43] Finally, a security module ***521*** contains instructions to interpret and react to data received from an associated security chip ***512***. The security chip ***512*** provides a first level of protection for the data stored on a removable media ***120***. In one embodiment, if an unauthorized attempt is made to use the data on the removable media ***120***, the security chip ***512*** in concert with the security module ***521*** disallows access to the removable media ***120***. The security chip ***512*** may be a contact or contactless chip embedded in the media sleeve ***100***.

[44] The controller ***410*** also includes an Input/Output module ***550*** that contains hardware and logic for interfacing with components in the media-drive assembly ***420***. The I/O module ***550*** includes sensor conditioning logic ***553*** that accepts command and control signals from the data bus ***513*** and the address bus ***517***. Additionally, various sensor signals ***561-569*** (shown in **FIG. 5** for illustrative purposes as the sensors themselves are located throughout the

terminal device ***400***) are part of a sensor array ***560*** that receives input events during the operation of the media-drive assembly ***420***. These signals are conditioned in a conventional manner and are manipulated by the command and control signals such that the SST module ***529*** is continuously updated with the current status of each of the sensors ***561-569.***

[45] The I/O module ***550*** also includes motor control logic ***555*** that also accepts command and control signals from the data bus ***513*** and the address bus ***517***. The motor-control logic ***555*** passes these control signals to the appropriate motors ***557-559*** (again, shown in **FIG. 5** for illustrative purposes as the motors themselves are located throughout the terminal device ***400***) in a conventional manner depending on which specific motor is to be activated.

[46] Finally, other switches and indicators ***585*** provide numerous conventional functions. For example, a reset switch (not shown) may be used to recover from an error. Other functions may include a display indicator, a numeric keypad, and/or other switches and indicators depending on the specific type of application and hardware configuration. Since these switches and indicators along with their related functions are well understood in the art, they are not discussed in any further detail herein.

[47] **FIG. 6** shows an isometric view of various components of a media-drive assembly ***420*** within the terminal device ***400*** of **FIG. 4** according to an embodiment of the invention. The various components are shown disposed on a base ***600*** that may the base of an enclosure, a circuit board, or any other base upon which the various components can be anchored for use. For ease of

illustration, anchor supports, wiring leads, wiring traces, external enclosure walls, and other extraneous devices and parts are not shown so that the operation of the media-drive assembly ***420*** can be more readily shown. Further, the particular arrangement of the various components is also for illustrative purposes only and should not be read as a limitation on the scope of the invention.

[48] The components of the media-drive assembly ***420*** operate in concert with the controller ***410*** (not shown in **FIG. 6**) to receive a media sleeve ***100*** having a removable media ***120***, to remove the removable media ***120*** from the media sleeve ***100*** and to place the removable media ***120*** on the media drive ***640*** for read and write operations. By way of overview, the operation of the media-drive assembly ***420*** is described briefly with respect to the motors ***557-559*** in the media-drive assembly ***420***. A more detailed description of the process follows in a discussion of **FIGs. 7A-7H**.

[49] The media-drive assembly ***420*** includes three motors **557-559**, each having sensors and components for manipulating the media sleeve ***100*** and/or the removable media ***120***. First, a rollor motor ***557*** operates to receive and eject the media sleeve ***100*** from an insert slot (not shown) on the terminal device ***400.*** When a media sleeve ***100*** is inserted, a card-input sensor ***561*** detects the presence of the media sleeve ***100*** and provides input to the controller ***410*** to turn on the roller motor ***557***. A roller ***612*** engages the media sleeve ***100*** and pulls the media sleeve ***100*** into the terminal device ***400*** until the media sleeve ***100*** comes to rest in a fully inserted position on a carriage assembly ***621***. The roller

motor ***557*** stops when a card home sensor ***563*** detects that the media sleeve ***100*** is fully inserted on the carriage assembly ***621***.

[50] Second, a carriage motor ***558*** operates to maneuver the carriage assembly ***621*** (via a well-known thread-screw technique) now having the media sleeve ***100*** thereon, toward a spreader ***625*** and a media drive ***640*** and away from a carriage-home sensor ***562*** Once the carriage assembly ***621*** has reached the spreader ***625*** and the spreader ***625*** has opened the media sleeve ***100***, a carriage-at-spreader sensor ***564*** is actuated and the carriage assembly ***621*** and spreader ***625*** are then moved (now in tandem) toward the media drive ***640*** so the removable media ***120*** may be extracted.

[51] Third, a cam motor ***559*** is actuated when the carriage-at-drive sensor ***565*** detects that the carriage assembly ***621*** and spreader ***625*** tandem has reached the media drive ***640***. This causes a pick-up arm ***641*** (actuated by a cam assembly ***631***) to engage the removable media ***120***. Then sensors ***566*** to ***569*** work in concert with the cam assembly ***631*** and cam motor ***559*** to place the removable media ***120*** on the spindle ***650*** of media drive ***640***.

[52] The media drive ***640*** may then use the removable media ***120*** in a conventional manner. When finished, the process operates in reverse as the removable media ***120*** is placed back in the media sleeve ***100*** and then ejected from the terminal device ***400***. Each of the preceding processes is described in greater detail below.

[53] **FIGs. 7A-7H** show a step-by-step representation of the overviewed processes described above with respect to **FIG. 6** according to an embodiment of

the invention. Only the physical movements of the method and the associated components are discussed in these figures to aid in clarity. As such, specific ancillary details, for example, media drive ***640*** operations or user interface operations have been omitted. The process of various methods of the present invention is discussed below in conjunction with **FIG. 8**. Note further, that the loading procedure is discussed in detail while the unloading procedure is not. It will be understood that the unloading procedure is effectively the reverse of the loading procedure.

[54] Beginning with **FIG. 7A**, a media sleeve ***100*** containing a removable media ***120*** is placed at an insert slot (not shown as the insert slot is part of the external enclosure) of the terminal device ***400***. The card input sensor ***561*** detects the presence of the media sleeve ***100*** and causes the roller motor ***557*** to activate in a clockwise direction, turning the roller ***612*** (which cannot be seen because it is underneath the media sleeve ***100*** in **FIG. 7A**). The media sleeve ***100*** which is engaging the roller ***612*** then moves along the direction indicated by arrow ***700*** toward the carriage assembly ***621***.

[55] **FIG. 7B** shows the media sleeve ***100*** situated on the carriage assembly ***621*** and, thus, ready to be moved toward the media drive ***640***. The roller motor ***557*** remains activated until the card home sensor ***563*** detects that the media sleeve ***100*** is fully loaded onto the carriage assembly ***621***. As can be seen in **FIG. 7B**, the media sleeve ***100*** is completely at rest on the carriage assembly ***621***. Now, the next step of the procedure, *i.e.*, retrieval of the removable media ***120*** from the media sleeve ***100***, may begin. As such, the

carriage motor ***558*** is activated and the carriage assembly ***621*** begins moving toward the spreader ***625***.

[56] **FIG. 7C** shows the media sleeve ***100*** being opened by the spreader ***625***. This part of the procedure begins when the carriage motor ***558*** is activated causing the carriage assembly ***621*** (with the loaded media sleeve ***100***) to move toward the spreader ***625*** in the direction indicated by arrow ***708***. The carriage motor ***558*** continues to run until the carriage-at-spreader sensor ***564*** detects that the carriage assembly ***621*** has reached the spreader ***625***. When this occurs, the media sleeve ***100*** is opened by the spreader pins ***626***, each pin aligning with the holes (***301*** and ***302*** of **FIG. 3**) formed on one side of the media sleeve ***100***. This spreading procedure for opening the media sleeve ***100*** is described in greater detail in **FIGs. 7D-7G**, in the following paragraphs. For now, once the media sleeve ***100*** is opened, the carriage assembly ***621*** (with the still loaded, but now open media sleeve ***100***) and the spreader ***625*** move, in tandem, toward the media drive ***640*** until the carriage-at-drive sensor ***565*** detects that carriage assembly ***621*** is positioned such that the pick-up arm ***641*** of the media drive ***640*** is directly over the removable media ***120.*** At this point, the carriage motor ***558*** is deactivated.

[57] In one embodiment, when the carriage assembly ***621*** is moving toward the spreader ***625***, a carriage-at-spreader detects that the carriage assembly ***621*** has reached the spreader ***625***. At this point, the pins ***626*** of the spreader ***625*** begin to open the media sleeve ***100***. However, prior to completely opening the media sleeve, a release (not shown) releases the spreader ***625*** from an anchored

position. This allows the spreader ***625*** to move, in tandem, with the carriage assembly ***621*** until the spreader ***625*** is stopped by a stopper (also not shown) near the media drive ***640***. The carriage motor ***558*** remains activated and the carriage assembly ***621*** is driven further into the pins ***626*** of the spreader ***625*** such that the media sleeve ***100*** opens up to a completely open position. Additionally, the pickup arm ***641*** is enveloped by the opening at this point. Prior to discussing the process of engaging and extracting the removable media ***120***, a more detailed description of the interaction of the media sleeve ***100*** with the spreader ***625*** is presented.

[58] Turning to **FIGs. 7D-7G**, which show the removable media extraction process in greater detail, only the media sleeve ***100*** and the spreader pins ***626*** are shown for ease of illustration. In **FIG. 7D**, as the media sleeve ***100*** approaches the spreader pins ***626***, it can be seen that the holes (***301*** and ***302*** described previously with respect to **FIG. 3**) are aligned with the respective spreader pins ***626***. As can also be seen, the upper portion ***110*** and the lower portion ***111*** of the media sleeve ***100*** are still closed together and sealed.

[59] In **FIG. 7E**, the media sleeve ***100*** engages the spreader pins ***626*** (*i.e.*, the spreader pins ***626*** enter the holes ***301*** and ***302***). Forces are exerted on both the upper portion ***110*** and the lower portion ***111*** of the media sleeve ***100*** such that the media sleeve "opens up." That is, the upper portion ***110*** bends (because it is formed from a flexible material) upward and the lower portion ***111*** bends downward to create an opening ***730*** between the upper portion ***110*** and the lower portion ***111***. As previously discussed with respect to **FIG. 1**, the short

sides ***160*** of the media sleeve ***100*** are attached to each other whereas the long sides ***161*** are not (or at least the long side with the holes ***301*** and ***302***). Thus, the long sides ***161*** may open up when the spreader pins ***626*** force the upper portion ***110*** and the lower portion ***111*** apart.

[60] In **FIG. 7F**, as can be more easily seen, (because the spreader pins ***626*** have been removed from the illustration for clarity), the opening ***730*** is formed when the upper portion ***110*** and the lower portion ***111*** of the media sleeve ***100*** have been spread apart. As such, a pick-up arm (not shown here) or other mechanism for retrieving the removable media ***120*** may enter the opening ***730*** in order to engage the removable media ***120***.

[61] In **FIG. 7G**, once the removable media ***120*** is engaged by a retrieval device (still not shown for clarity), the removable media ***120*** may be removed from the media sleeve ***100*** for use in the media drive ***640*** (also not shown here).

[62] **FIG. 7H** again shows a larger overview of the media-drive assembly ***420*** now at a final stage such that the removable media ***120*** has been extracted and is ready to be accessed by the media drive ***640***. Returning to the same point in the previous discussion of the extraction procedure, prior to the discussion of **FIGs. 7D-7G**, the carriage assembly ***621*** with the opened media sleeve ***100*** is maneuvered to a position at the media drive ***640*** as detected by the carriage-at-drive sensor ***565***. At this point (which is not illustrated in **FIG. 7H**), the carriage motor ***558*** is deactivated as the media sleeve ***100*** is positioned such that the pick-up arm ***641*** is inside the opening ***730*** (as shown in **FIG. 7F**) of the now spread apart media sleeve ***100***. Thus, the pick-up arm ***641*** is positioned over the

removable media ***120*** such that it is ready to engage the hub ***150*** of the removable media ***120***.

[63] The pick-up arm ***641*** may be raised or lowered in a vertical direction by being actuated by the cam assembly ***631*** which is actuated by the cam motor ***559*** (again, in a well-known thread-screw technique). The cam assembly ***631*** includes five levels ***632-636*** that engage a roller ***663*** attached to the pick-up arm ***641***. Based on the level of the cam assembly ***631*** that the roller ***663*** of the pick-up arm ***641*** is resting on, the entire pick-up arm ***641*** may be raised or lowered accordingly. The five levels include a pick-up-arm-home level ***632***, a disk-grab level ***633***, a pick-up-arm-up level ***634***, a disk-on-spindle level ***635*** and a pick-up-arm-parked level ***636***.

[64] As the cam motor ***559*** moves the cam assembly ***631*** in the direction indicated by the arrow ***735***, the cam-at-home sensor ***566*** is de-actuated and the position of the pick-up arm ***641*** changes according to the corresponding level. As can be seen, at the cam-assembly-home level ***632***, the pick-up arm ***641*** is at its highest level. Then, as the cam assembly ***631*** moves along the direction indicated by arrow ***735***, the pick-up arm ***641*** lowers to the disk-grab level ***633*** such that the pickup arm ***641*** may grab the removable media ***120***.

[65] At this point, the pick-up arm ***641*** engages the hub ***150*** of the removable media ***120***. In one embodiment, the pick-up arm ***641*** includes microfingers (not shown in detail) that may be actuated to spread apart when at the disk-grab level ***633*** such that the hub ***150*** of the removable media ***120*** is engaged. The surface of the cam assembly ***631*** which faces the media drive ***640*** is contoured

such that a detent ball ***662*** is actuated which causes the microfingers to spread apart to engage the hub ***150*** of the removable media ***120***. A pick-up-verified sensor ***569*** is actuated if the removable media ***120*** has been successfully engaged. If the pick-up-verified sensor ***569*** is not actuated, the procedure loops several times until successful and the removable media ***120*** is properly engaged by the pick-up arm ***641***. That is, the cam motor ***559*** reverses the cam assembly ***631*** back to the cam-assembly-home level ***632*** and then moves the cam assembly ***631*** forward again (thus, un-engaging and re-engaging the detent ball ***662***) until the pick-up is verified.

[66] Once the removable media ***120*** is engaged and the pick-up-verified sensor ***569*** indicates so, the cam motor ***559*** continues to move the cam assembly ***631*** along the direction indicated by the arrow ***735***. As can be seen, the pick-up arm ***641*** is raised to the pick-up-arm-up level ***634*** so that the removable media ***120*** (now picked up by the pick-up arm ***641***) is no longer touching any portion of the interior of the media sleeve ***100***. The cam motor ***559*** deactivates when the disk-picked-up sensor ***567*** is actuated so as to allow the carriage motor ***558*** to activate and reverse the carriage assembly ***621*** away from the media drive ***640***.

[67] At this point, the carriage assembly ***621*** (along with the empty media sleeve ***100***) is maneuvered away from the media drive ***640*** as actuated by the carriage motor ***558*** (in reverse). Once the carriage assembly ***621*** reaches its home position (as detected by the carriage-at-home sensor ***562***), the carriage motor ***558*** is deactivated and the cam motor ***559*** is again activated so that the

cam assembly ***631*** may be moved such that the removable media ***120*** may be lowered to the spindle ***650*** (which cannot be seen in **FIG. 7H** because the removable media ***120*** is already resting on it) of the media drive ***640***.

[68] As such, the cam assembly ***631*** continues to move along the direction indicated by the arrow ***735*** and the pick-up arm ***641*** is lowered to its lowest level, the disk-on-spindle level ***635***. At this point, a back edge of the cam assembly ***631*** disengages the detect ball ***662*** and the microfingers of the pick-up arm ***641*** release the removable media ***120*** so that it rests upon the spindle ***650***. Then, the cam assembly ***631*** continues to the final position where the pick-up arm ***641*** is raised to the pick-up-arm-parked level ***636*** so the removable media ***120*** (now released and resting on the spindle ***650***) may spin. Here, the cam motor ***559*** is deactivated as the pick-up-arm-parked sensor ***568*** is actuated. With the removable media ***120*** now on the spindle ***650*** of the media drive as shown in **FIG. 7H**, the media drive ***640*** may interface with the removable media ***120*** in a conventional manner.

[69] **FIG. 8** is a flow chart of a method for manipulating a credit card form factor having a removable media ***120*** and for storing data on and/or retrieving data from a removable media ***120*** stored in a credit card form factor according to an embodiment of the invention. Read and write routines to and from computer-readable media are well-known in the industry and will not discussed in greater detail. However, the manipulation and handling of the media, *i.e.*, media loading, unloading, error handling, etc. is discussed in the following paragraphs.

[70] The terminal device ***400*** uses a series of routines and subroutines to maneuver and use the removable media ***120*** as well as the media sleeve ***100***. In one embodiment, the controller ***410*** controls the steps of the terminal device in a state-machine manner. That is, the controller ***410*** transfers "control" to various states which wait for a particular input event (or a time-out event) in order to proceed to the next state. Thus, the following steps are described in terms of control to different states with the understanding that the controller 410 handles the majority of the states.

[71] When a terminal device ***400*** is first powered on, an initialization and diagnostics state is entered at step ***801***. This routine checks the status of the controller ***410*** and the media-drive assembly ***420*** to ensure that all components are in proper working condition. If determined at step ***803*** that the initialization routine was not completed successfully, the controller ***410*** transfers control to an error-resolution state at step ***810*** and an error-resolution routine is carried out in a conventional manner to determine the cause of the problem during initialization.

[72] If, however, the initialization routine is completed successfully, the controller ***410*** transfers control to a home state routine at step ***805***. In the home state routine, all motors are initialized to a home position as indicated by the various sensors described above. Again, if the home state routine is determined, at step ***807***, to have not been successfully completed, the controller ***410*** again transfers control to the error-resolution state at step ***810***. If, however, the home state routine is determined to have been successfully completed, the

controller ***410*** transfers control to an idle state at step ***820***. The terminal device ***400*** is now ready to begin one of three sub-routines; a card-load routine, a host-state routine, or a card-unload routine.

[73] In a typical progression of steps, after the initialization and home routines described above are completed, the terminal device ***400*** is be ready to accept a credit card form factor in its insert slot (as it is likely that upon start-up there is no credit card form factor or removable media already in the terminal device ***400***). When a user inserts a media sleeve ***100*** into the terminal device ***400***, the card-in sensor ***661*** detects the presence of the media sleeve ***100*** at step ***830*** and the controller ***410*** transfers control to the card-load state at step ***831***. The media sleeve ***100*** is then manipulated as described above with respect to **FIGs. 7A-7H** and the removable media ***120*** is extracted from the media sleeve ***100*** and placed on the spindle ***650*** of the media drive ***640***. If it is determined at step ***832*** that the card was not loaded properly, the controller ***410*** again transfers control to the error-resolution state at step ***810***. If, however, it is determined that the card-load subroutine has been completed successfully, the controller ***410*** returns control to the idle state at step ***820*** to await another subroutine.

[74] With the removable media ***120*** on the spindle ***650*** of the media drive ***640***, the media drive ***400*** is ready to access the data stored on the removable media 120. A media-ready signal, detected at step ***840*** causes the controller ***410*** to transfer control to a host state at step ***841***. In the host state, various known routines for manipulating data stored on media may be executed. For example, data may be retrieved from the removable media ***120*** and transmitted to a

remote device (not shown) for use in an application program. Once all data manipulation routines have completed, as determined at step ***842***, an application program running within the host state (or alternatively running on a host computer (***450*** of **FIG. 1** with temporary control of the terminal device) generates an acknowledgment signal to indicate that the controller ***410*** may transfer control back to the idle state at step ***820***.

[75] In the last subroutine, a card-unload state is entered at step ***851*** when the system determines, at step ***850***, that the removable media ***120*** that is still on the spindle ***650*** of the media drive ***640*** is to be returned to the media sleeve ***100***. The media sleeve ***100*** is then manipulated, in a reverse manner, as described above with respect to **FIGs. 7A-7H** and the removable media ***120*** is replaced inside the media sleeve ***100***. The media sleeve ***100*** is then ejected from the terminal device ***400***. If it is determined, at step ***852***, that the media sleeve ***100*** was not unloaded properly, the controller ***410*** again transfers control to the error-resolution state at step ***810***. If, however, it is determined that the card-unload subroutine has been completed successfully, the controller ***410*** returns control to the idle state at step ***820*** to await another subroutine.

[76] In another embodiment of the invention, the removable media ***120*** may be inserted into media sleeve (not shown, although ostensibly the same as media sleeve ***100***) other than the media sleeve ***100*** in which it was originally enclosed at the beginning of the method described above. In this alternative, while the removable media ***120*** is on the spindle ***650*** of the media drive ***640***, the original empty media sleeve ***100*** is ejected from the terminal device ***400***, and a new

empty media sleeve is inserted. Then, when the method reaches the card-unload subroutine, the removable media ***120*** is placed inside the new empty media sleeve and then ejected form the terminal device ***400*** as described above.

[77] From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention.